population in order to replace the lost selections. They have kept improving the selected materials until they became stable and uniform, based on their own criteria. There are only a few farmers who have the capacity to use all of the selected materials at a time. Since labor is limiting factor, farmers have discarded those materials that are not of use to them. Storability is another factor, because of the humid conditions of the program area—seeds lose their viability in a very short time.

- Therefore, there is a need to provide farmers with support in maintaining their selections and training them how to manage their seeds to preserve longevity.

Reasons for distribution and nondistribution

In order to determine farmers' acceptance of the segregating materials distributed, the reasons for distribution and nondistribution of materials in the field were examined (table 1). In the same survey conducted by CONSERVE in 1998, it was found that 31% of the farmers distributed the segregating lines they obtained from the center to other farmers. Most of them reasoned that it was ready for mass production. Another reason was that the person who requested it was a close relative.

Table 1. Farmers' Reasons for Distribution and Nondistribution of Segregating Lines to Other Farmers, Arakan Valley Complex, Cotabato, Philippines

Distribution	Nondistribution
Relative/kin	Minimum quantity
Morpho-agronomic characteristics	Infested by rats
Ready for mass production	Tungro infested
	Not yet uniform
	Mixed
	Infested by rice bugs
	No selection done
	Milled
	Eaten by ducks
	Neighbors have the same seed

When farmer-partners did not distribute the breeding lines to other farmers, it was because they only had a minimum quantity of the material. Some said this was because of an infestation of pests, such as rats and rice bugs, that the materials were not yet uniform, that the materials were mixed, etc. Some farmers were very reluctant to distribute because of the small quantity given. In time—with further field testing, improvement, and multiplication—farmers started to appreciate and find ways to obtain, develop, and increase the quantity of good varieties.

Reasons for adoption and rejection

There are also reasons why farmers adopt or reject varieties given to them. These reasons can be agronomic, morphological, gastronomic, social/cultural, and technological (table 2). Agronomic

Table 2. Why Farmers Adopted or Rejected the Breeding Lines Distributed, Arakan Valley Complex, Cotabato, Philippines

Adoption	Rejection
Agronomic:	**Agronomic:**
• adaptable to the area	• cannot adapt to the area
• resistance to lodging	• susceptible to lodging
• resistance to pests and diseases	• susceptible to pests and diseases
• medium maturity	• maturity is not the same
• high yielding	
• early maturing	
Morphological:	**Morphological:**
• long panicle	• discouraged by the segregation
• medium height	• height (tall)
• shiny seeds	• late maturing
• thin (lemma and palea)	
• good tillering ability	
• filled grains	
Gastronomic:	**Gastronomic:**
• good eating quality	• eating quality is not good
• aromatic	
• glutinous/oily	
Social/cultural:	**Social/cultural:**
• low cost in production	• busy with other obligations
• neighbors are encouraged	
Technology:	**Technology:**
• learn selection	• laborious

reasons include resistance of the breeding lines to pest and disease, resistance to lodging, and adaptability in the area. Adaptability was measured as having good standing performance/growth under specific environmental conditions.

Morphologically, farmers adapted breeding lines according to the length of panicle, number of productive tillers, grain characteristics, and plant height. Eating quality or palatability was also considered. Other farmers mentioned the low cost of production and knowledge gained in selection techniques as reasons for adoption.

The reasons for rejection were also classified according to agronomic, morphological, gastronomic, social/cultural, and technological. Usually farmers rejected the material because of the susceptibility of the segregating lines to lodging, while others were discouraged by non-uniform maturity or because of the height and maturity of the material. Few farmers rejected the materials for poor eating quality but others were hampered by other responsibilities and said that the activities were too laborious.

It was generally learned through the farmers' evaluation that farmers discard those materials that do not fulfill their selection criteria, especially materials that are susceptible to pests and diseases. Sometimes, however, rejection can lead to success. One of the farmer respondents rejected a selection that he then gave his neighbor. The neighbor grew the variety successfully and later multiplied the seeds for other farmers.

Conclusions

The approach initiated by CONSERVE has enhanced the farmers' capacity to develop varieties from the segregating materials distributed. Farmers' direct involvement with these materials has helped to providing access to diverse genetic materials, that has led, in turn, to opportunities for them to develop what they want from the genetic materials distributed. This approach has also helped in promoting farmers' involvement in farm-based varietial-improvement activities. In general, the approach is better if farmers are involved.

Summary

1. There are two PPB approaches initiated by CONSERVE, namely, researcher-managed or on-station trials and farmer-managed trials.
2. There were 22 single crosses made between upland and lowland rice by the center, coded as CONSERVE's crosses (CC). Ten crosses survived at the first filial generation and were planted on-station for three filial generations before distribution to farmer-partners. One hundred lines were derived and distributed to 89 farmer-partners, with a minimum of five lines per partner at 5–10 grams per line.
3. All the segregating lines given to farmer-partners were grown in their own fields. Two methods of selection were practiced: bulk and pedigree.
4. Nineteen lines distributed from six single crosses (CC1, CC2, CC5, CC7, CC13, and CC20) are still maintained by the farmer-partners. CC5 and CC13 are the most common. In their fields, farmer-partners keep two to three lines, on average. Farmers who maintained many lines have a greater capacity to manage and store them, resulting in diffusion of selections.
5. Selections are continuously enhanced in farmers' fields, leading to an increase in stable lines, but as this happens, the number of lines in the farmer's fields decreases. Farmer's selection criteria and the adaptability of the segregating materials contribute to this.
6. Farmers distribute selections for reasons such as readiness of the selection for mass production and requests for materials from close relatives. Reasons for nondistribution were because of the small quantity of materials, infestation by pests and diseases, the materials were not yet uniform, they were mixed, etc.
7. Farmer-partners adapted the segregating materials distributed for resistance to pests and disease, resistance to lodging, and adaptability in the area. Some adapted length of panicle, number of productive tillers, grain characteristics, and plant height.

8. Reasons for rejecting materials were due to susceptibility of the segregating materials to lodging, non-uniformity, and maturity. Some farmers felt that the activities were laborious and conflicted with other responsibilities.

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Enhancing Farmers' Participation in Plant Breeding: Community Biodiversity Development and Conservation Program (CBDC), Bohol Project, Philippines

Hidelisa M. de Ramos

Abstract

The Community Biodiversity Development and Conservation Program (CBDC) is a global undertaking aimed at halting or minimizing genetic erosion and strengthening the farmers' role in on-farm conservation and development of plant genetic resources (PGR). It also aims to seek ways on how the formal and informal sectors can complement each other in on-farm conservation and development. In this paper, the project's general approach is illustrated in a case study on rice, conducted in Bohol, Philippines. The objectives of the study were to increase the genetic diversity of rice planted by farmers and to determine farmers' criteria for evaluating and selecting rice. Genetic materials were distributed to farmer-partners, evaluated by farmers, and subsequently exchanged within the community through the local exchange system. Workshops were conducted every season to identify researchable areas and to design field experiments. Community workshops were also held to analyze research results and identify new problems for the next season. Farmers decided which varieties or technology to adopt after each season, based on their observations and evaluation of the on-farm research. The study documented the results of two types of farmers' evaluation of the varieties.

Introduction

Farmers have traditionally exchanged and shared seeds among themselves. Seed sharing and exchange enable farmers to evaluate and select new crop varieties that suit their needs and preferences and adapt to specific environmental conditions in their fields (Berg 1994). Farmers are therefore able to continually produce diverse crop varieties that are specifically adapted to local needs and conditions.

However, when the Green Revolution started in the 1960s, the conservation and development of crop varieties were mainly taken over by agricultural research centers (Berg 1994). For instance, the International Rice Research Institute (IRRI) developed new varieties of rice that displaced many of the traditional varieties. Formal breeding programs not only displaced local varieties but also much of the farmers' role in crop conservation and development (Salazar n.d.).

Formal breeding programs differ from farmers' methods of developing new varieties. Breeders set breeding objectives with broad rather than specific adaptability in mind (Berg 1994). This means that the new varieties are designed to adapt to a wide range of field conditions. High yield is the top consideration for breeders, while farmers consider yield along with other characteristics deemed important, such as aroma and eating quality.

Furthermore, breeders produce new varieties in very favorable environments. Varietal trials are carried out in fields that are highly fertile and highly seeded (Atlin and Frey 1989), where optimum amounts of fertilizers are applied. The new varieties, however, perform differently in farmers' fields where conditions are more variable and management practices are different.

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This project is implemented by the Southeast Asia Regional Institute for Community Education (SEARICE), a regional NGO working on issues about access and control of plant genetic resources (PGR) and farmers' rights, and currently implementing community-based PGR projects in Southeast Asia.

Ceccarelli (1989) states that direct selection of varieties in the target environment is an efficient breeding strategy since this will produce varieties that satisfy specific farmers' needs and conditions better. This calls for a decentralized and participatory breeding approach where farmers are involved in the development and selection of new varieties. Participatory breeding will generate greater crop diversity in farmers' fields that can meet the diverse needs and conditions of farmers.

Approaches and methods in on-farm research

The Community Biodiversity Development and Conservation Program (CBDC) is a global undertaking aimed at halting or minimizing genetic erosion and strengthening the farmers' role in on-farm conservation and development of plant genetic resources (PGR). It also aims to seek ways on how the formal and informal sectors can complement each other in on-farm conservation and development.

The Southeast Asia Regional Institute for Community Education (SEARICE) is implementing the CBDC project in Bohol, Philippines. It started in 1994 and focuses on conservation and development of rice, corn, and root crops, such as cassava, sweet potato, and yam (*Dioscorea alata*). The project's general approach in conducting participatory on-farm research is shown in figure 1. The project, together with farmer-partners in the community, conduct workshops every season to identify researchable areas and to design experiments to be conducted in the field. On-farm research is evaluated at three levels: by the staff, by individual farmers, and by the farmers' group. Another community workshop is conducted at the end of each season to analyze research results and to identify new research problems for the succeeding season. Farmers decide which varieties or technology to adopt after each season, based on their observation and evaluation of the on-farm research.

The key players in the project's approach participatory plant breeding (PPB) and participatory varietal selection (PVS) are shown in figure 2. The genetic materials distributed by the project to farmer-partners come mainly from three sources: local communities; formal institutions, such as

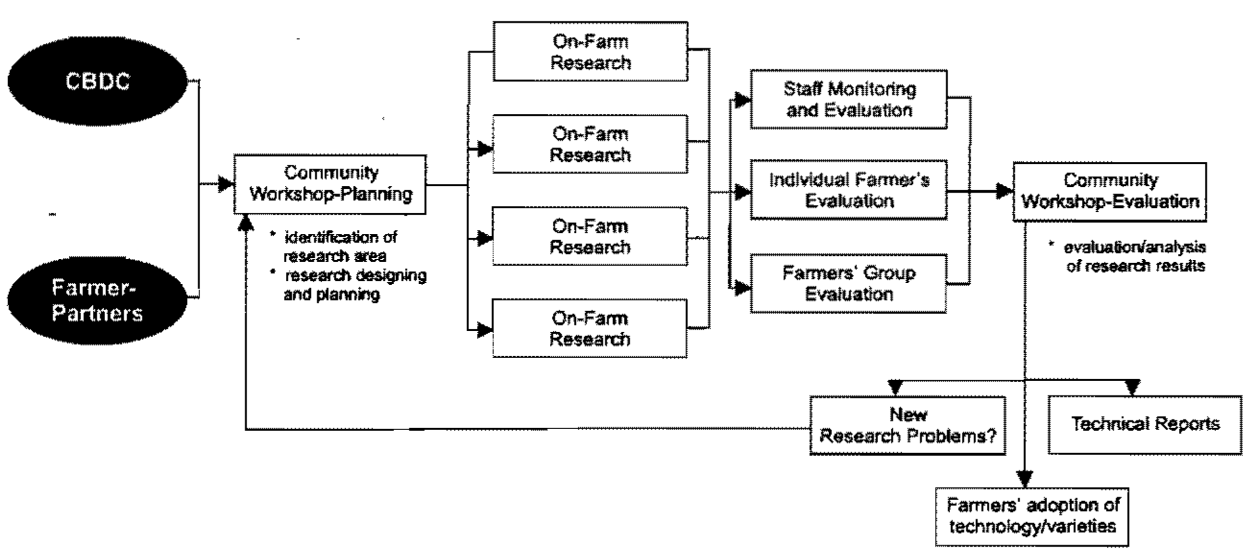

Figure 1. CBDC Bohol Project's approach in on-farm participatory research

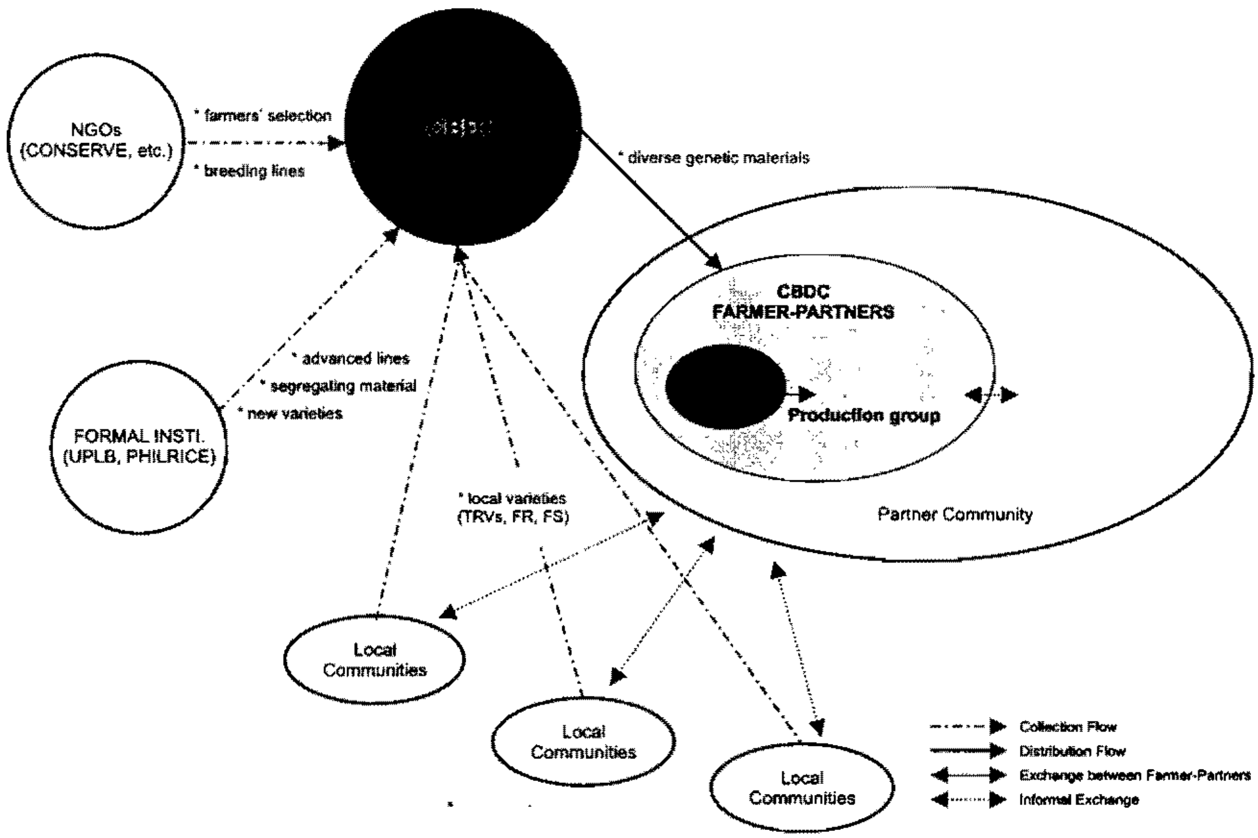

Figure 2. Key players in PPV/PVS

the University of the Philippines–Los Baños (UPLB) and the Philippine Rice Research Institute (PHILRICE); and nongovernment organizations (NGOs), like the Community-Based Native Seeds Research Center (CONSERVE). The distributed genetic materials consist of stable varieties, such as traditional varieties, farmers' selections, and formal release varieties. The project also distributes segregating lines (F1-F8) collected from NGOs and formal institutions. These genetic materials are evaluated by farmers and subsequently exchanged within the community through the local exchange system.

Methodology

The project's general approach is elaborated in a case study conducted in collaboration with the Research and Development Department of the Central Visayas State College of Agriculture, Forestry and Technology (CVSCAFT), a local institution.

Fifteen varieties of rice were distributed to 12 farmers in Zamora village in Bilar town during the second cropping season from October 1999 to March 2000 (table 1). The materials came from different sources and consisted of both white and red varieties. Boholanos are known to prefer red rice varieties. Each farmer received three varieties at 0.5 kg per variety. The farmers grew the varieties using their own management practices in combination with organic fertilization. The methods of

Table 1. Types of Varieties Distributed to Farmer-Partners

Set	Variety Name	Origin/Sources	Seedcoat color	No. of farmer recipients
1	MB	Farmers' selection from RC 10	Red	
	08	Local variety	White	3
	CC 13-3-4-3	NGO-bred and released to farmers at F3	White	
2	03	Local variety	White	
	RC 28	Formal release	White	4
	Los Baños	Local variety	White	
3	CFS-JR-06	Farmers' selection from Japanese variety	Red	
	MS 1-29	NGO/farmer-bred	White	3
	RC 4	Formal release	White	
4	66 Puwa	Farmers' selection from IR 66	Red	
	MS 2-AV	NGO/farmer-bred	White	4
	Japan	Local variety	White	
5	Ceres	Local variety	Red	
	MS 13	NGO/farmer-bred	White	3
	CC 13-3-4	NGO-bred and released to farmers at F3	White	

distribution and trial arrangements with farmers were based on lessons gained by the project in previous years of conducting on-farm experiments and studies.

The study documented the results of two types of farmers' evaluation of the varieties. In one evaluation, farmers who received the same set of varieties ranked the varieties in comparison with IR66, the most commonly planted variety in the village. Farmers ranked the varieties according to different parameters they themselves identified. Ranking in each parameter ranged from one to four, with four representing the highest preference by the farmers. In the other evaluation, the farmers participated in a field day to observe and evaluate all the varieties as standing crops. Farmers identified the varieties they preferred and the reasons for their preferences.

Objectives of the study

The objectives of the study were

1. to increase the genetic diversity of rice planted by farmers in Zamora village
2. to determine farmers' criteria for evaluating and selecting rice

Results and discussion

Farmers' preferences in a variety

Farmers identified at least 13 specific traits they look for in a variety (table 2). Their criteria are very comprehensive, ranging from percent germination to yield. Farmers evaluated the varieties from seedling stage until harvest. Yield is one of the major criteria, as shown by the identification of related traits such as big grains, long panicles, and high tillering ability. In addition to yield, maturity also matters to farmers since early maturation allows them to maintain at least two cropping seasons per year. From the evaluation results during the farmers' field day, farmers cited one addi-

Table 2. Sample Matrix Ranking of Varieties by Farmers Receiving Same Set

Preferred Traits	MB	08	CC 13-3-4-3	IR 66
1. High percent (%) germination	4	1	2	3
2. Healthy and strong seedlings	4	2	1	3
3. Panicles				
a. long	4	3	4	3
b. low % of unfilled spikelets	4	4	4	3
c. low shattering	3	4	4	3
d. heavy branching	3	3	4	4
4. Big, healthy spikelets	4	4	3	3
5. High tillering	3	4	4	4
6. Early maturing	3	3	4	4
7. Strong culm	4	4	4	3
8. Resistant to pests	4	4	4	3
9. Medium height	4	4	3	3
10. High yield	4	3	4	3
Average ranking	3.7	3.3	3.5	3.2

Note: 4 = highly preferred; 1 = least preferred.

tional criterion not identified in the matrix ranking, namely, tolerance to water logging (table 3). This criterion is significant because certain areas of the village are waterlogged. This is a good example of selection by farmers for a very specific field condition. On the other hand, formal breeding programs would be unable to capture such selection because varieties released from the formal sector are generally bred for broad adaptability.

Culture, as it relates to diversity conservation and development, is also not addressed by the formal sector. For example, Bohol farmers maintain a diversity of red rice varieties, either traditional varieties or farmer-developed varieties (table 1). Boholanos are known to prefer red rice because it is generally equated with better eating quality. Farmers also claim that they can work longer in the field after eating red rice (CBDC 1996). In fact, local red rice is priced higher in the market than local white rice. Red rice is also preferred by a number of ethnic groups in Luzon and Mindanao (Borromeo, personal communication). However, the Philippine Seed Board has not released any red rice variety since it was established in the 1950s (Borromeo, personal communication).

Increased genetic diversity

Seven of the 15 varieties distributed were replanted by the farmers who participated in the trial. Previous to the trial, farmers in Zamora were planting only three varieties (CBDC and CVSCAFT 1999). This represents a significant increase in the number of varieties planted in the community after one season.

The selected varieties have diverse qualities. Two are farmers' selections, three came from an NGO-farmer breeding program, one from the formal sector, and one is a locally adapted variety (table 4). The replanted varieties either ranked higher (in sets 1, 3, and 5) or slightly lower (in sets 2 and 4) in comparison to IR 66, the check variety.

Table 3. Result of Collective Farmers' Field Evaluation of Standing Crop

Variety name	Preferred traits	No. of farmers who preferred the variety
MS 13	Uniform hull color and absence of spots Healthy, big and many spikelets White grains Long panicle Strong culm, lodging resistant Tolerant to water logging	10
CFS-JR-06	Good panicle Healthy and big spikelets Red grains Strong culm, lodging resistant Tall	10
MS 2 – AV	Healthy and long panicles Early maturing Tolerant to leaf folder and rice bug Lodging resistant Resistant to diseases Uniform height Short height	7
MS 1-29	Healthy spikelets Many but small spikelets Uniform hull color, absence of spots Long panicle Tolerant to diseases	7
MB	Big panicles and grains Uniform hull color, absence of spots High tillering Tolerant to water logging Lodging resistant Big culm Resistant to leaf folder Tall	4
Los Baños	Many spikelets and panicles Heavy branching Tall Relatively late maturing compared to other varieties	3
66 Puwa		1

Varieties that scored high in both the field day evaluation (table 3) and the matrix ranking (table 4) had a higher rate of adoption than the other varieties with lower scores. This implies that if farmers' criteria are be taken into consideration and varietal performance is evaluated in farmers' fields using farmers' practices, then varietal adoption rates could increase considerably. This could shorten the time for a material to be evaluated and adopted by farmers. Release of a new variety in